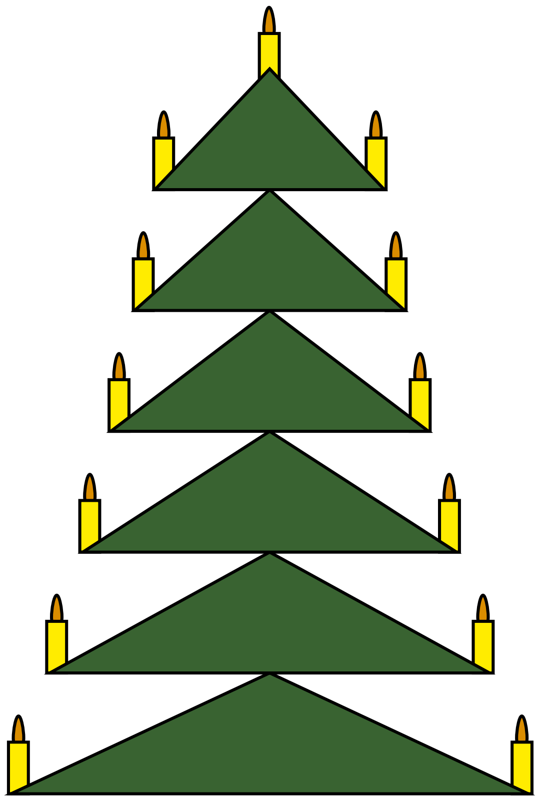
Winter trees

Reasoning in the classroom



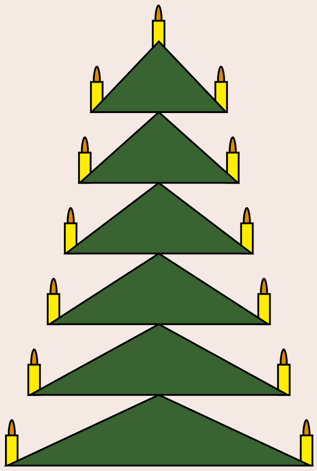
Support materials for teachers

Year 5

Llywodraeth Cymru
Welsh Government

Year 5 Reasoning in the classroom – Winter trees

These Year 5 activities encourage learners to think about number patterns and how they continue.



Activity 1

Winter trees

Learners use their reasoning skills to answer questions about the number of candles on different-sized 'trees'.

Includes:

- Winter trees questions
- Markscheme

Activity 2

Think dotty

They investigate the number of dots in different-sized patterns and find simple rules.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Think dotty
- Resource sheet – Think dotty

Activity 3

Matchsticks

They produce reasoned arguments to support their thinking.

Includes:

- Explain and question – instructions for teachers

Reasoning skills required

Identify	Communicate	Review
Learners work independently, choosing how to solve simple problems.	They explain their thinking, justifying why something must, or must not, be correct.	They draw conclusions, linking numerical and spatial data.

Procedural skills

- Addition
- Multiplication and multiplication tables

Numerical language

- Odd/even numbers
- Square numbers
- Differences
- Rectangle, square
- Multiples

Activity 1

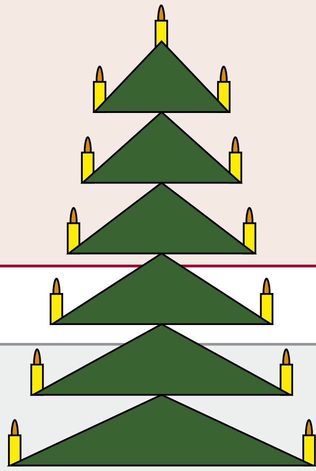
Winter trees

Activity 1 – Winter trees

Outline

This activity encourages learners to think about how patterns are created, then to use that knowledge to solve problems.

Note that to avoid learners focusing solely on the pattern of 'add 2', the trees are deliberately not drawn in order of size.



You will need

Winter trees questions
One page for each learner

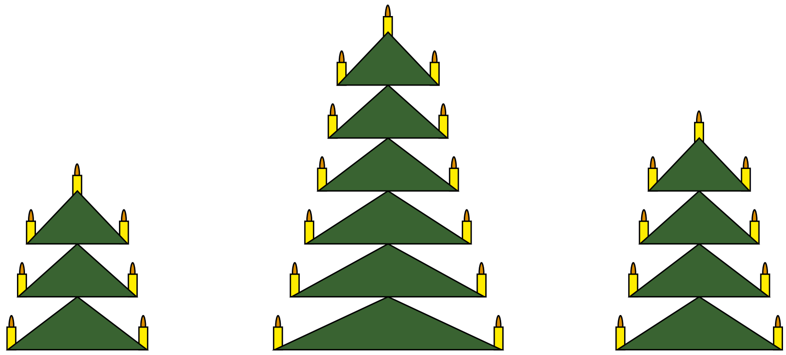
Markscheme

Children in Year 5 make trees from triangles.

Each tree has **1 candle on top**.

Each triangle has **2 yellow candles**.

Examples:



Anna's tree has **5 triangles**.

How many candles does it have? candles

1m

Nia's tree has **21 candles**.

How many triangles does it have? triangles

1m

Alun says his tree has **24 candles**.

Alun must be **wrong**. Explain why.

2m

Activity 1 – Winter trees – Markscheme

Q	Marks	Answer
i	1m	**11** candles

ii	1m	**10** triangles

iii	2m	States that the number of candles must be **odd** (or 25 or 23) and explains why, i.e. because there is 1 (or 3) at the top Or States that the number of candles each side would be **$11\frac{1}{2}$** (or $10\frac{1}{2}$ or not a whole number) and explains why, i.e. because there is 1 (or 3) at the top
	Or 1m	States that the number of candles must be **odd** Or Shows the value **25** or **23** or **$11\frac{1}{2}$** Or States that there is **1** (or 3) at the **top** Or States that there is **1 too few** or **1 too many** candles, e.g. • Needs another one

◄ **Accept '24 is even'**

Activity 1 – Winter trees – Exemplars

Part iii

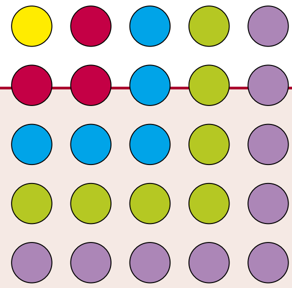
Alun is wrong because every tree must have a odd amount because the 2 times table is even and 2 is on each triangle but there is 3 on the top.	Correct; **2 marks**
Alun is wrong because every triangle has two candles on and so its an even number because an even + odd = odd so it has to be odd because ones on top and 24 is even not odd.	Correct; **2 marks**
Alun is wrong because he has even number he shold 23 or 25 because you shold one on top	Correct; **2 marks** • This learner's numerical communication is not as strong as the ones above, but it does show understanding.
Alun is wrong because 24 is an even number of candles.	24 is even; **1 mark** • This learner shows some understanding, implying that the number of candles should be odd, but does not explain why.
Alun forgot to put one candle on the top.	1 at the top (or 1 too few); **1 mark** • This response also shows some understanding but it is incomplete as it does not explain how they know that Alun forgot.
Because Aluns numbers are Even and all the rest are odd	Number must be odd; **1 mark** • For a complete response, this learner needs to explain why even numbers are not possible.
Because you would only have 2 candles on one triangle	Incomplete; **0 marks** • Had this response referred to the 'top' triangle, it would have scored 1 mark as it implies that there should be 1 or 3 candles. However, as it stands it is incomplete.

Activity 2

Think dotty

Activity 2 – Think dotty

or



Outline

This activity is designed to carry on from **Activity 1 – Winter trees**.

Learners investigate how number patterns continue, this time by considering groupings of coloured dots.

You will need

WB **Whiteboard – Think dotty**

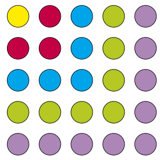
R **Resource sheet – Think dotty**
Half a page per pair/group

Coloured pencils

Activity 2 – Think dotty

Explain

Show **Think dotty** on the whiteboard and ask learners to describe what they see.

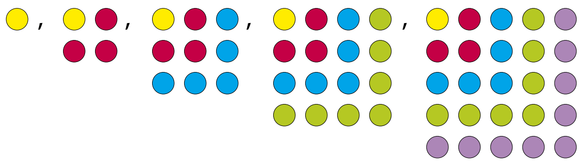


Then give each pair/group a copy of the **Think dotty** resource sheet and ask them to use different colours to continue the pattern.

What number patterns can they find, and how do those number patterns continue?

(One pattern is in the number of dots of each colour. This goes 1, 3, 5, 7, 9, etc. The number of dots increases by 2 each time.

Another pattern is in the total number of dots at each stage. This goes 1, 4, 9, 16, 25, etc.



These numbers are the square numbers: the number of dots goes up by 2 more each time, i.e. +3, +5, +7, etc.)

Or

Draw and continue the pattern on squared paper.

Question

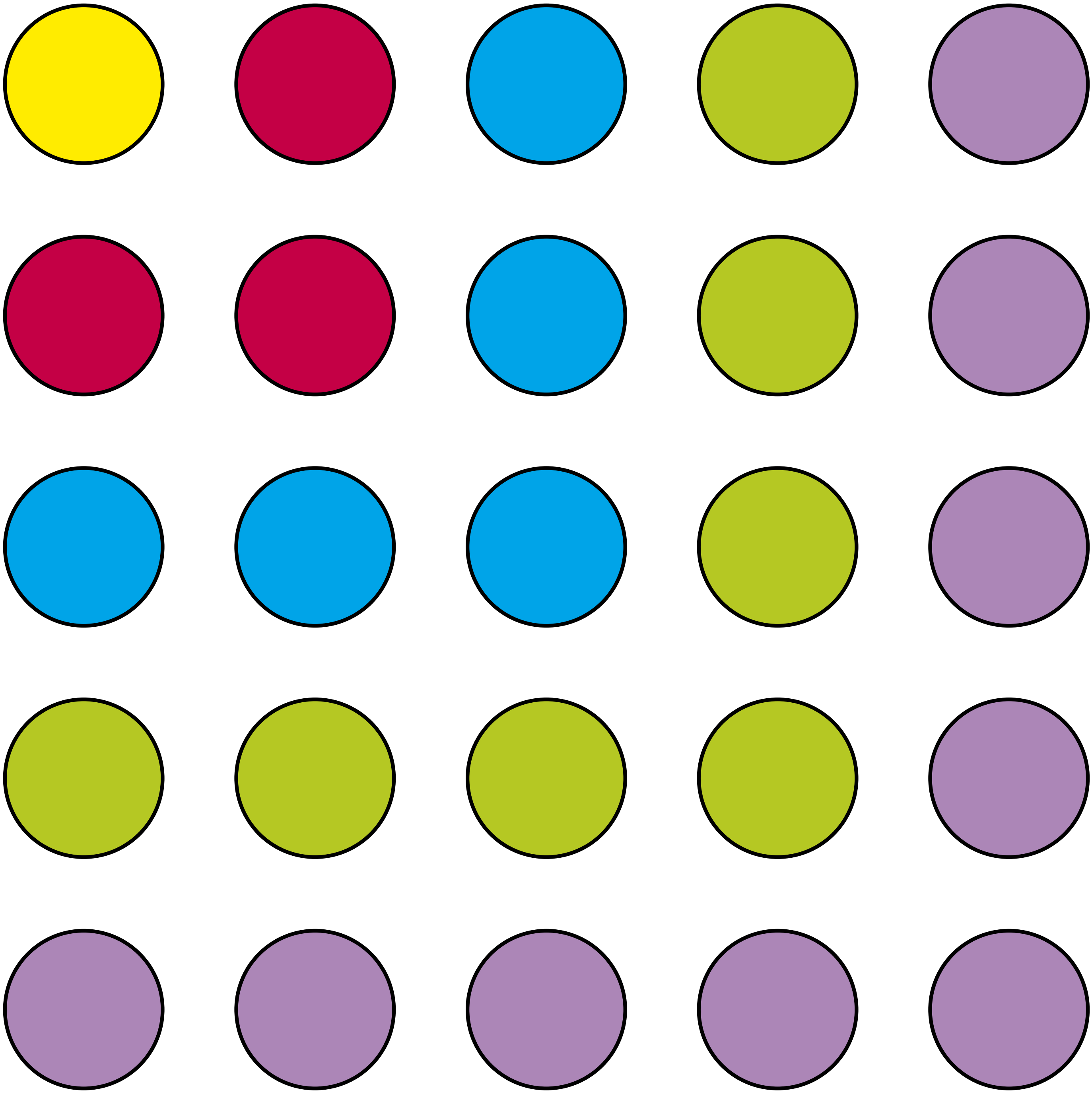
- How can you work out the number of dots in the next pattern without drawing it?
- Will there ever be an even number of dots of one colour? How do you know?
- Suppose the 10th colour is brown. How many brown dots would there be? How can you work it out without adding on? *(19, because there would be two sets of 9 dots – one horizontal row and one vertical column – and 1 in the corner.)*
- In the 10th pattern, how many dots would there be altogether? *(100, because 10 × 10 = 100)*

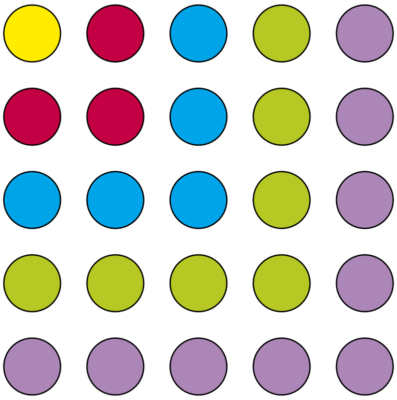
Extension

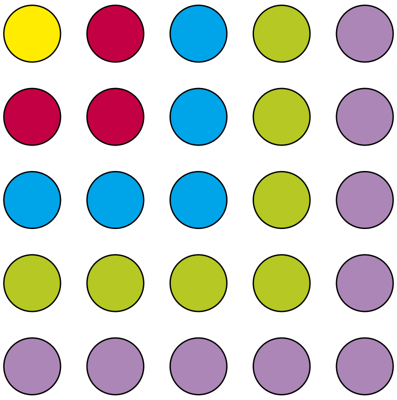
- If we put what we have found about both patterns together, we can see that . . .

  1 + 3 = 4
  1 + 3 + 5 = 9
  1 + 3 + 5 + 7 = 16, and so on.

  Can you find a quick way to work out the sum of the first 20 odd numbers?
  (The first 2 odd numbers add to 4 which is 2 × 2, the first 3 odd numbers add to 9 which is 3 × 3, the first 4 odd numbers add to 16 which is 4 × 4, and so on, so the first 20 odd numbers add to 20 × 20 = 400.)



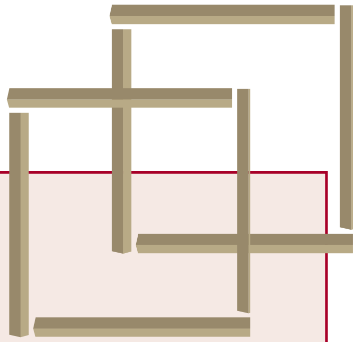




Activity 3

Matchsticks

Activity 3 – Matchsticks

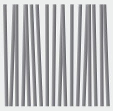


Outline

This activity is designed to carry on from **Activity 1 – Winter trees** and **Activity 2 – Think dotty**.

Learners use matches, or lolly sticks, or any 'sticks' that are the same length, to make rectangles of different dimensions. They produce reasoned arguments as to why the number of matches must always be an even number.

You will need



Each pair or group will need a large number of matches, or lolly sticks, or any 'sticks' that are the same length

Activity 3 – Matchsticks

Explain

Give each group a pile of sticks and ask them to make a rectangle of their choice, e.g.

Ask each group how many sticks they have used, then write the answers on the whiteboard.

Now ask what they notice. *(All the numbers are even.)*

Learners then work in their groups. Ask them to make a rectangle that has an odd number of sticks, without putting one stick on top of another or breaking the sticks. If they decide that this can't be done, can they explain why it is not possible?

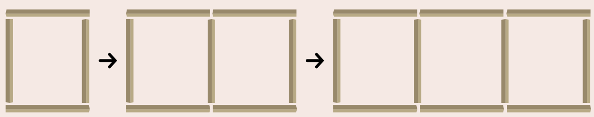
(The number of sticks will always be even. This is because the total number of sticks on a vertical and horizontal side of the rectangle is the same as the total number on the other vertical and horizontal side, so the number of sticks in two adjacent sides is doubled. Any number doubled is even.)

Question

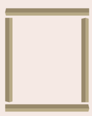
- Do you all agree that it is not possible, or are some people in your group not sure?
- Is your explanation clear? Would someone else understand it?
- Can you predict how many sticks you need for different-sized rectangles, e.g. a rectangle that is 6 sticks by 5 sticks? *(22, because $6 + 5 = 11$ and $11 \times 2 = 22$)* How does this link to what you know about perimeter of rectangles?
- What happens if you use the sticks to make squares? What do you notice? Can you explain why this happens? *(The number of sticks will always be a multiple of 4. This is because the number of sticks on each side is the same, and there are 4 sides to a square.)*

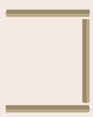
Extension

- Here is a different pattern. It starts with 4 sticks, then increases by 3 each time like this.



Can you find a quick way to work out how many sticks would be in the 20th pattern?

(In the 20th pattern there would be 1 shape like this 

and 19 shapes like this  *, $4 + 19 \times 3 = 61$ sticks altogether.)*